

Taste Thresholds for Sodium Benzoate and Sodium Sorbate in Apple Cider*

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PRESERVING FRESH FRUIT JUICES from microbial spoilage is a problem of long standing. Chemical preservatives provide the simplest method of accomplishing this purpose, but they must be used with caution because of the danger of adverse physiological effects and the problem of off-flavors. Sodium benzoate has been used for many years in preserving apple cider, and is generally accepted as a safe preservative for this purpose. It is, however, subject to the disadvantage that when added in the usual concentration (0.10%) it imparts a burning after-taste which many persons find objectionable.

Recent experiments (1,4) have shown that sorbic acid and its sodium salt are useful in the preservation of cider from the action of yeasts and molds, and may be substituted for sodium benzoate in comparable amounts. Whether or not it was equally subject to objections on the basis of taste was not definitely known. Ferguson and Powrie (1) state only that sorbic acid in concentrations up to 0.035% could not be detected by a taste panel. It was felt that a definite comparison of the taste of sodium benzoate and sodium sorbate should be made, based on both trained panel and consumer panel methods.

EXPERIMENTAL

The cider used in these experiments was obtained from a commercial cider plant. The apples were pressed and the juice was treated with $\frac{1}{2}$ pound of Pectinol 5B^c per 100 gallons and allowed to stand and settle at 40° F. for 48 hours before bottling. The cider was then frozen in the bottles and kept in frozen storage until ready for use.

The sodium benzoate used was a U.S.P. grade (Baker's).^c The sodium sorbate was prepared as a 25% solution by dissolving sorbic acid (Carbide and Carbon Chemicals Company) in sodium hydroxide solution and adjusting to pH 8.0. Since the addition of sodium benzoate or sodium sorbate to cider causes a slight increase in pH, the control samples were adjusted to the same pH by the addition of sodium hydroxide solution in order to eliminate any difference in taste due to differences in pH.

TESTS WITH TRAINED PANEL

These tests were carried out in a darkened room, illuminated only by a 25-watt red bulb. All samples were tasted at room temperature. A panel of 27 members was chosen in order to

have 20 available for each test. Panel members were trained to recognize the tastes of sodium benzoate and sodium sorbate in cider, and were then given several preliminary tests at relatively high concentrations. To determine threshold levels, triangle tests were used, the comparisons being made between cider containing preservative at a given level and a control containing no preservative. Panel members were told which preservative was present but not the concentration. Each triangle consisted of one treated and two untreated samples or one untreated and two treated samples, half of the triangles being made up in each way. The tasters were asked to record the code letter of the odd sample and to state whether or not it was the one with the preservative or without. In this way, the probability of obtaining a correct answer by chance was only one in six. Twenty judgments were obtained in each test. Under these conditions, 7 correct answers are required for significance at the 5% level, and nine for significance at the 1% level (3).

The threshold concentration was determined by beginning the tests at a relatively high concentration (0.10% in both cases), at which the difference in taste was obvious, and then reducing the concentration until the number of correct answers was not significant. Table 1 indicates that sodium benzoate was detected at 0.03%, but not at 0.02%. Sodium sorbate was detected at 0.05%, but not at 0.04%. In order to make the results more widely applicable, tests were run in a similar manner on a different sample of cider prepared later in the season and differing considerably in total solids and acidity.

Results, shown in Table 2, indicate that sodium benzoate was detected at 0.04%, but not at 0.03%, and that sodium sorbate was detected at 0.05%, but not at 0.04%. We may thus conclude that the taste threshold of the trained panel for sodium benzoate in cider was 0.04% and that of sodium sorbate 0.05%.

The next step in the experiment was to determine whether there is a detectable qualitative difference between the tastes of sodium benzoate and sodium sorbate in cider. For this purpose, a sample containing 0.04% sodium benzoate was compared with one containing 0.05% sodium sorbate, since these levels were approximately equivalent with respect to the ability of the panel to detect their presence. These samples were presented as triangles as in the previous tests. The tasters were asked to pick the odd sample and to identify it by stating which preservative it contained. Only 3 out of 20 tasters gave correct identifications, indicating that at these levels the taste of sodium sorbate cannot be distinguished qualitatively from that of sodium benzoate.

Some commercial users of sodium benzoate have stated their belief that certain brands of sodium benzoate are less easily detectable or less objectionable in cider than others. In order to test this hypothesis, samples of 6 additional brands of food-grade sodium benzoate were obtained, and each of these was compared to the brand used in the previous tests. The comparisons were made between samples containing 0.10% of each brand of sodium benzoate. In each test, the tasters were asked to pick the odd sample and to state whether it tasted better or worse than the other two. The results are shown in Table 3. Since it was required not only to choose the odd sample, but to give a preference as well, a total of 8 choices in favor of one brand or the other would be required for significance (2). Inasmuch as such a preference was not shown in any of the comparisons, it may be concluded that none of the 6 additional brands tested was significantly superior or inferior in taste to the brand originally used.

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^c Mention of trade names or products does not constitute recommendation by the U. S. Department of Agriculture over similar products not mentioned.

TABLE 1

Taste comparisons of preservative-treated cider with untreated cider. Triangle test—probability 1 in 6.

	Preservative						
	Sodium Benzoate				Sodium Sorbate		
	Concentration				Concentration		
	0.10 %	0.05 %	0.03 %	0.02 %	0.10 %	0.05 %	0.04 %
Total number of judgments.....	20	20	20	20	20	20	20
Number of correct answers.....	18	9	7	5	15	8	5
Significance.....	<1%	1%	5%	a ¹	<1%	5%	a ¹

¹ Not significant.

TABLE 2

Taste comparisons of preservative-treated cider with untreated cider. Triangle test—probability 1 in 6.

	Preservative			
	Sodium benzoate		Sodium sorbate	
	Concentration		Concentration	
	0.04 %	0.03 %	0.05 %	0.04 %
Total number of judgments.....	20	20	20	20
Number of correct answers.....	9	6	10	5
Significance.....	1%	b ¹	1%	b ¹

¹ Not significant.

TABLE 3

Taste comparisons of seven brands of sodium benzoate in cider (0.1% concentration) triangle test, 20 judgments.

Brand A compared with each other brand.

Brand	B	C	D	E	F	G
No. who identified odd sample.....	2	3	9	6	4	8
No. who preferred taste of Brand "A".....	2	0	5	3	3	1
No. who preferred taste of other brand.....	0	3	4	3	1	7
Significance.....	None	None	None	None	None	None

CONSUMER PREFERENCE TESTS

The results of tests by a trained panel in regard to preservatives in cider are of scientific interest and perhaps of some value for practical guidance. However, they do not necessarily reflect accurately the reactions of the cider-drinking public. In order to secure information of more practical usefulness, it was necessary to carry out tests of the consumer-preference type. These tests were of the paired-comparison type; 100 judgments were obtained in each test. The panel consisted of employees of the Eastern Regional Research Laboratory, and included both scientific and non-scientific personnel. Members of the trained panel were excluded from participation in the consumer-preference tests.

The tasters were given no information as to the nature or purpose of the tests. They were given the following form to fill out:

Taste sample.....first.

1. Which sample do you prefer.....?
(If you have no preference, make a guess.)
2. Does sample.....have an objectionable off-flavor?
Yes or No.....
3. Does sample.....have an objectionable off-flavor?
Yes or No.....
4. Your name.....

The code letters of the two samples were reversed halfway through each test in order to eliminate the effect of code-letter bias. The order of presentation of samples was also reversed in half the cases.

In the first test, cider containing 0.10% sodium benzoate

was compared with untreated cider. Of 100 tasters, 67 preferred the untreated cider and 33 preferred the cider containing benzoate. Since 61 correct judgments are required for significance at the 5% level, and 64 for significance at the 1% level (2), this result indicates a preference for the untreated cider which is significant at the 1% level. The results are shown in Table 4. An objectionable off-flavor was noted in the benzoate-treated samples by 47 tasters; 4 tasters reported an off-flavor in the control.

In the second test, cider containing 0.10% sodium sorbate was compared with untreated cider. Of 100 tasters, 56 preferred the untreated cider and 44 preferred cider containing sorbate. This is not a sufficient difference for significance at the 5% level (2). An objectionable off-flavor was noted in the sorbate-treated sample by 27 tasters; 15 tasters reported an off-flavor in the control.

TABLE 4

Consumer-preference panel comparisons of preservative-treated cider with untreated cider. Paired comparisons, 100 judgments.

	Control	Benzoate	Control	Sorbate
Number who preferred.....	67*	33	56†	44
Number who found off-flavor in.....	4	47	15	27

* Significant at 1% level.

† Not significant.

Of 82 tasters who participated in both of the consumer-preference tests, 35 preferred the control samples to the preservative-treated samples in both cases; 21 preferred control to benzoate but preferred sorbate to control; 13 preferred benzoate to control, but preferred control to sorbate; and 13 preferred both preservative-treated sample to the controls.

No comments were solicited other than the answers to the questions on the form, but some tasters volunteered further remarks. Those who objected to the taste of the preservative noted an unpleasant after-taste or biting astringency. Those who preferred the preservative-treated samples generally stated that they had more flavor or tang, or complained that the control was too bland or tasteless. It is obvious that a minority of tasters like the taste of preservative in cider.

SUMMARY AND CONCLUSIONS

A trained taste panel was able to detect the presence of sodium benzoate in cider at a minimum concentration of 0.04%. Sodium sorbate could be detected at a concentration of 0.05%.

When compared at the minimum detectable concentrations (0.04% for benzoate and 0.05% for sorbate), there was no detectable qualitative difference between the taste of sodium benzoate and that of sodium sorbate in cider.

Of six additional brands of sodium benzoate tested, none were significantly better or worse in taste than the brand originally chosen for the tests when compared at 0.1% concentration.

A consumer-preference panel of 100 tasters showed

a significant preference for untreated cider over cider containing 0.10% of sodium benzoate. There was no significant preference for untreated cider over cider containing 0.10% sodium sorbate. Almost twice as many tasters found an objectionable off-flavor in benzoate-treated cider as in sorbate-treated cider.

On the basis of these tests it would appear that sodium sorbate shows a definite advantage over sodium benzoate as a preservative in cider from the standpoint of taste when used at relatively effective concentrations.

LITERATURE CITED

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